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ABSTRACT

The rate of new technology-driven innovations for information delivery has accelerated over the past three decades. New information delivery formats in the 1950s and 1960s included microforms and, in response to demands from librarians, indexing and abstracting services began to make their publications available on this medium. Electronic processing and delivery of machine-readable records became a reality in the late 1960s; magnetic tapes were developed, and online distribution followed. Online usage on a broad scale occurred much more quickly than predicted, first as bibliographic entries, then as abstracts, and finally full-text formats became available online. Recent information delivery mechanisms and issues include floppy discs, downloading, vertical integration, value added, electronic publishing, optical discs, and CD-ROM. These technological applications have had a vast impact not only on the way information is processed and delivered to its point of use, but also on how it is used. During the decade ahead, the need for carefully weighed decisions will be greater than ever. Material pertinent to this topic is listed in an accompanying 34-item bibliography. (Author/KM)

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INFORMATION DELIVERY OPTIONS OVER THREE DECADES

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Introduction

To give this lecture in memory of Miles Conrad is a special honor. Many of you, and most, if not all previous lecturers in this series, knew Miles Conrad. I did not, and yet for 19 years I have worked with a staff who did and for the past 10 years I have held the position at BIOSIS that was his at the time of his death.

In 1969, Phyllis Parkins(1) wrote, "Everything about Miles Conrad suggested dependability and strength....his serious and thoughtful manner, his consistently unhurried, deliberate approach to managing situations or events.....He inspired in those who knew him unquestioned confidence in his ability to decide matters, always on a firm, just and reasonable basis. Moreover, he was not a man to waste his energy on trifles: the very fact that Miles Conrad would devote time, effort and thought to a problem or program seemed therefore to attest to its importance."

In deciding on a topic for this lecture, I felt I wanted to choose one that he would have thought worthwhile. Certainly he would have been comfortable with the theme of this conference. For it was under his direction that BIOSIS introduced the use of data processing equipment. This led to B.A.S.I.C., the first KWIC subject index employed in the abstracting and indexing field. I wondered if I should speak to the continued progress of NFAIS, given the role that he played in establishing the Federation.

I reviewed the previous lectures in this series(2). Cooperation, sharing, hope, change, survival and the future were frequent topics. I realized that the future and struggle for survival that was referred to in those lectures is now.

In the end, the task was simplified because the Program Committee asked me to make my lecture a keynote as well. Since the conference theme, "Innovations in Information Delivery," had already been chosen, my topic was fairly well indicated. I have decided that a look into the past and how that past has brought us to today's circumstances, would provide an appropriate backdrop for the sessions to follow. I will, then, review the options and the need for decisions that have prevailed in the information industry from the late fifties, when the Federation was founded, until the present time.

Miles Conrad Lecture, National Federation of Abstracting and Information Services 28th Annual Conference, Philadelphia, PA, March 2-5, 1986.

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Purpose

The conference theme suggests options in information delivery. After centuries of sameness in the distribution of secondary information products, i.e., print on paper only, those of us providing such services over the past three decades have been challenged with a continuing series of options. The rate of new technology-derived innovations for information delivery has accelerated over that thirty-year period. This presentation will illustrate that in more than one instance, the availability of technology was the driving force behind innovation, rather than its having been a tool used by the services for meeting the product needs of users of information.

Early Options for Information Delivery

Microforms. In the late 50's and early 60's much attention was focused on alternatives to the printed page for mass storage of information that could be manipulated rapidly by machine. Photographic and electronic devices were under study for these requirements. Microphotography provided great density of stored information and its low cost led to growing popularity of microforms(3). The National Microfilm Association's microfiche standards were published(4) as well as a microfilm standard by the government(5) that was intended for all scientific and technical reports by federal agencies and their contractors. Libraries were concerned about paper deterioration, so microfilm was studied as a possible backup medium as well as a shelf space saver(6). In January, 1959, for the first time in scientific history, a serial research publication, Wildlife Diseases(7) was issued originally and exclusively in microform.

The decision by abstracting and indexing services to make their publications available on microform was made in response to demand from librarians. They saw it as enabling them to cope with the storage problems resulting from the phenomenal growth of the literature following World War II. Libraries were converting hard copy primary journals to microfilm to conserve library shelf space. Secondary services were faced with decisions concerning distribution of their products in this medium, whether to permit libraries or film vendors to microfilm existing holdings, or whether to provide and distribute microfilm versions themselves. Furthermore, if they were to provide microforms, should they lease or sell them, and should they be distributed to print customers only in order to hold off further erosion of hard copy sales. Although the introduction of xerography had made it possible to copy print, microforms were among the first output media that could be used as a master for duplicates. As I examined these technologies, i.e., xerography and microforms, I observed that the number of problems each presented seemed to correlate with the capability each had for duplication of the original. For example, when xerography was introduced, the publishers' main concern was single copying, while microforms were perceived as a systematic threat because of their capability to generate complete sets of the originals. The relative unimportance of this technology as a systematic problem is easily seen now, after the fact. At the time, it was an all-absorbing concern. We shall see this phenomenon, I suspect, in other "problematic" technologies of the present and future.

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Electronic Processing/Machine-Readable Records. For a number of the abstracting and indexing services, the much-talked-about and long-awaited goal of delivering bibliographic information services from electronic storage became a reality in the late 60's. Long before bibliographic files were available for searching in computer-readable form, the memory features of electronic computers were recognized as holding great promise for secondary services. Many studies were directed at applying this technology to the production of abstracts and indexes(8). Schultz(9) wrote in 1968, "Technology is modifying the techniques and creating the textual 'image' to be published by offering a choice between 1) the storage of the record as character strings in machine manipulable form, and 2) storage of the image (either as copies of the printed citation and/or abstract, or else in microform)." Although the secondary services were to find that the machine-readable records provided all sorts of derivative uses, e.g., searches, bibliographic subsets, and current awareness services, the primary motivation for their use was to drive conventional output devices, i.e., printers.

What was seen initially as a way to a series of procedural changes to stave off soaring production costs as well as a way of preparing material for photocomposition, was soon recognized as a desirable information delivery vehicle--a supplement to hard copy and one that could enhance speedy retrieval of citations for the end user. Some services were able to develop tapes for searching as a by-product of the generation of a tape for the primary purpose of photocomposition for hard copy. Others, however, not yet operating with a system designed for photocomposition, re-keyed from print to generate tapes in order to be able to offer this fast delivery medium to users through such intermediary services as were provided by several computer centers. The services offered by the University of Georgia and the University of Pittsburgh were examples.

The decade of the 60's was a period when most major services were making decisions concerning the distribution of their information in electronic form. Magnetic tapes were available for batch searching, and therefore, the decision to become involved in this delivery mechanism was a result of technology having led the development of services, rather than the deliberate decision to develop services using the technology. The technology, and the products and services that were developed thereby, presented abstracting and indexing services with the necessity for decisions concerning distribution and the resultant impacts on existing, as well as new, markets. Should they sell or lease tapes to the information centers who, at that time were able to perform batch searching only? How best to guard against the threat that this form of distribution would cause declines in the use of the printed products? How should the services be priced, i.e., should the recovery of production costs for this vehicle versus cost of producing hard copy be a goal?

Since most services were creating magnetic tapes as a supplemental activity, there was also the option of going back and creating retrospective magnetic tapes from the archival hard copy record. If this was to be done, how far back was it practical to go, or how far back was it reasonable to expect demand to justify the effort and cost? Would the centers be able to search these tapes effectively? In fact, could they search the tapes created on the current data base effectively? If not, would the data base producers suffer the consequences of a reputation for having produced a poor data base? Would that reputation go to the center for its ineptness in searching? Whether or not to produce

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tapes as a delivery option, which centers could search them effectively, what restrictions to place on ownership and use, were all critical decisions to be made by the abstracting and indexing services of the late '60s.

Online Distribution. Online computer-based information services were introduced in the U.S. before they were in Europe or other parts of the world. Data bases for online searching were especially attractive to the secondary publishers because, by now, the data base producers were generating computer-readable magnetic tapes as part of the production process. The tapes were relatively inexpensive to duplicate and they made possible the creation of a master file from which all products and services could be derived. They were the result of a rapid conversion by most of the major secondary services to computer-assisted photocomposition and were first available on Lockheed's DIALOG system and System Development Corporation's system, ORBIT. These became operational in 1972(10). As a result of these developments, an atmosphere of excitement was created among the secondary services in the early 70's, much as the potential for laser optical disks excites us today.

Initial projections were that online searching would become an accepted way of information transfer over an extended period of years. In fact, online usage on a broad scale occurred much more quickly. In 1974 it was predicted(11) that within two years a million articles would be identified or retrieved by computer search and that by 1985, the number would reach some 4 million. In 1983, it was reported that the number of searches grew from less than one million to over 8 million between 1975 and 1983(14). Some 400,000 online users around the world were estimated by 1983(12), compared with less than 50,000 in 1975. Revenues from online service were projected to reach between 2.1 and 3.1 billion dollars by 1983. The online revolution was being discussed at both national and international meetings and in fact was the subject of a special symposium titled "The Online Revolution," sponsored by the International Council of Scientific Unions Abstracting Board (ICSU AB) in 1978(13).

Again, the decision by the secondary information publishers to distribute their data bases online was the result of available technology, rather than planned development of a product to serve a need. Nevertheless, these abstracting and indexing services had a choice of entering or not entering the online data base market, with its associated advantages and disadvantages--the opportunity for new markets, quick services and new revenues vs. greater dependency on intermediaries, costly educational programs and risk of subscriber migration from hard copy. Some moved more quickly than others into online distribution. In the long run, it proved to have been a wise move, because the growth of online delivery and its impact on sales and use of information has far exceeded that of any other development since the beginning of abstract journals. So, on the one hand the decisions to move into the online arena were indeed a way of offsetting the loss of hard copy sales due to the soaring cost of those services. On the other hand, had online services not been available and had migration not occurred, would the previous volume of hard copy sales have continued and averted the rapidly rising prices? These questions can be pondered but definitive answers are evasive.

Other technical developments were essential to the success of online, such as magnetic disk packs, remote access data base management systems, low cost

terminals and effective telecommunications networks. With these developments it was only a matter of time before other innovations in information delivery and other options with respect to these innovations were available to the data base producers.

Full Text Abstracts Online. Initially, online bibliographic data bases were provided, for the most part, without abstracts and with the assumption that online access would lead the user back to the printed copy. However, some users wanted abstracts online and data base producers saw the opportunity to expand a service as well as a potential source of additional revenues. And so, full abstract text online became a delivery option.

Another question for data base producers was whether to merge abstract text with the bibliographic files or to offer full text tapes in parallel with bibliographic files. In the latter option, it was only a matter of time before the vendors were merging these two files for full text searching. This led to some redundancy between retrieval terms found in the text and index terms provided by the service. Also, it raised doubt in the minds of many as to whether full text searching would eliminate or lessen the need for indexes. If so, what impact might this have on retrieval, user satisfaction and economics of data base production, not to mention the concern for its impact on the sales of hard copy.

Recent Delivery Mechanisms

Floppy Disks. IBM introduced floppy disks in 1970, but it was a decade later before they were used as a delivery medium for bibliographic data bases(19). ERIC, NTIS and BIOSIS are delivering information via this mechanism. The product is essentially SDI, i.e., a customized subset of the file delivered for use on a microcomputer. This delivery option has introduced a level of convenience not previously available from magnetic tape, as it delivers large quantities of information, packaged compactly, into the office, the laboratory, the classroom or the home for searching on microcomputers. This medium has created a refreshing wave of excitement among end users.

Downloading. An inevitable result, perhaps, of the decline in cost of microcomputers and their growing popularity and ease of use with floppy disks was the increased potential for electronic transfer of information, i.e., downloading. Downloading may be defined as the transfer of online data from a mainframe computer (usually the vendor service's system) to a microcomputer or intelligent terminal. The term, downloading, appeared in the subject index of the Annual Review of Information Science and Technology for the first time in 1983(15), although the concept of repackaging and re-using online information had been the subject of several earlier meetings and papers(16,17). A good, concise description of downloading and some of the associated problems and concerns was discussed last year in an article by Martha Williams in Science(18).

The repackaging and re-use of electronically-stored information is now both straightforward and tempting. The concerns of the data base producers are that downloading could hurt the legitimate distribution without user fees accruing to them, to say nothing of their concern that downloaded information would be incorporated into new data bases, and thereby deprive them of revenues for use of their data.

Strictly speaking, downloading does not fit my list of information delivery options, because even though producers found it was undesirable generally, they had no choice; it was happening anyway. Some users found it desirable but from the data base producer's standpoint it was not legal. The only choice was whether or not to permit downloading--to make it legal. Many opted to develop policies and draw up downloading agreements between themselves and users, whether the user be the vendor or the microcomputer operator. These agreements permit the transfer from magnetic store to magnetic store, with associated permissions and restrictions concerning use. For example, most permit downloading for one time use, but not continued storage and re-use. To my knowledge, very few users have opted to sign downloading agreements with the data base producers. Why not? The causes are purely speculative. It is possible that downloading is a myth, and that users are not equipped or motivated to do so. It may be that traditional "fair use" attitudes prevail, or that the "hassle" of executing formal agreements for an infrequent event discourages users. And, of course, the whole process may be price sensitive. The answer is probably all of the above.

Vertical Integration. Further applications of the technologies discussed so far have led to a phenomenon called vertical integration. Vertical integration is the providing of information services by a producer that have traditionally been provided by supplier or vendor. This practice seems to be a growing trend among data base producers. For example, some are moving into the vending area, and primary journal publishers and vendors are moving in the direction of information delivery from an electronic store, bypassing the secondary services. One must look carefully at the reasons for decisions for vertical integration on the part of producers before making judgment calls. For example, technology and online delivery led us to a position where the producer lost contact with his customers and users. To be responsive to his users is essentially impossible in the existing atmosphere, because it is not always possible to know who they are. Vertical integration is seen as a way of bringing the producer back in contact with his users. Other advantages of vertical integration are: 1) the need to expand the profit base, 2) more control over product pricing and distribution, and 3) greater ability to provide highly specialized products and services(15).

It is obvious from this summary of developments over the past three decades, that after some 300 years of sameness with print on paper as the only commonly used medium, many delivery formats are available. Some of these represented choices that were made by the data base producers and as a result, the producers were better able to serve the user and at the same time assure, or calculate the threat to, their financial security. Other developments were not the result of options or decisions at all. In some cases, choices were not available. Progress by the services was led by technological advances, rather than resulting from decisions made on behalf of the services for their own well-being.

From this review, spanning some 30 years, we can draw the following conclusions:

1. As we study the new and exciting innovations and options for information delivery that will be discussed at this conference, we should be reminded of the past three decades of exciting developments.

2. Lessons learned from experiences with those developments are applicable in evaluating delivery innovations of the 80's.

3. While the options now available promise to be revolutionary, they are not without precedent in terms of their potential for marked and lasting impact on ways in which information is stored, delivered and used.

Electronic Publishing

Today secondary services are challenged by the opportunities available by electronic publication. Three concerns to be posed at the outset are:

1. Electronic publication may be shaping the future of the publishing industry, and secondary services particularly.

2. It may be doing so without the services' active decisions for determining that future.

3. Regardless of the decisions that we may make concerning optical disk technology, CD-ROM and other options, the eventual outcome cannot be predicted.

In 1979, Don King wrote, "In the future.....I feel that it is going to be more and more difficult to distinguish between retrieval of information used for identification of publications, and retrieval of the full text of primary information, because the process and technology used for online search and retrieval can be used in the future for transmission of full text. The two kinds of retrieval will eventually blend into a single system(19)." That statement helps bring into focus what I will discuss now.

In a broad and general sense, the era of electronic publishing began in the 70's with online delivery. However, electronic publishing can be discussed in a different context today, because of developments in various segments of the information transfer chain.

To illustrate, the Council of Biology Editors, The Society for Scholarly Publishing and the International Federation of Scientific Editors are all organizations whose purposes are similar to a great extent, i.e., to further the dissemination of scientific and scholarly communication through good editorial and publishing practices. These are organizations whose membership consist principally of editors of primary journals, and journal and book publishers. It is noteworthy that they are dedicated to purposes not unlike those of the abstracting and indexing services. Yet for many years secondary information services far surpassed the primary publishers in their experimentation with and application of electronic publishing to their roles as information providers. As has been stated before, in some cases this was the result of positive decisions and in other cases, the result of technology taking the lead. Without exception, it was motivated by economics.

Was the economic motivation lacking in the case of primary journals? Perhaps it was because of economics that they were slow to register interest and implement aggressive actions to become involved in the applications of new technology for the preparation of manuscripts. The availability of reasonably

priced word processors, however, has made a dramatic change in that attitude, and authors now make significant use of this technology for composition and text editing. Standards are necessary before manuscripts will be transferred electronically from author or editor to publisher on a broad scale. A major project on standards for this purpose is in progress, under the sponsorship of the American Association of Publishers. It has been predicted(20) that by 1990, 80% of all authors will prepare their papers using this technology. According to an AAP survey, reportedly(21) 80% of authors expected to prepare manuscripts electronically, and 70% of publishers were prepared to accept manuscripts electronically in 1985. The cost advantages are obvious, for both the publishers and authors, and so the motivation is real.

Only a decade ago, in the early days of online services, the lines of separation between primary and secondary publishers were clear. The primary publishers produced journals and the secondary publishers published abstracts and indexes to papers in those journals. About ten years ago, when the data base producers began to put those indexes and abstracts up online, the boundaries between primary and secondary publishing started to blur. In spite of a sluggish start to generate copy in electronic form, some publishers were already composing their journals from digitized formats. The potential for secondary services to receive abstracts and citations directly from the publisher before the journals were published was obvious, although not without technical complications. With that potential recognized, the opportunity for primary and secondary services to reverse their respective places in the sequence of announcing publications was apparent, as were new opportunities for cooperation -- or, on the contrary -- polarization.

Not only were the roles of primary and secondary publishers changing, but those of telecommunications companies and vendors, as well. While some advantages of shifting roles have been cited, there are dangers also. For example, data base quality might suffer to achieve profits, the risk of monopolies being formed, and the possibility of U.S. information resources being sold to foreign organizations have been mentioned in the literature(18). Various concerns have been brought about by the publishing of books and journals electronically and the storage of full text for electronic manipulation on demand. The publishers, including the scientific societies who sponsor the journals, are looking for opportunities for revenues from user fees without jeopardizing hard copy sales. A few comprehensive electronic publishing systems are well underway for this purpose. They offer the advantage of eliminating printing, mailing and storage costs of infrequently used materials.

These developments have caused, with justification, publishers to look with interest at the possibilities for new revenues, and vendors to look at opportunities provided by adding full text data bases. Information Access Company's experimental electronic journal, Information Publishing: An Electronic Journal, was mounted on DIALOG in January, 1985(22). Could this be the forerunner of electronic journals in the scientific and other disciplines?

The possibility of scholarly literature being published in electronic format only causes authors to ask how such publications would be cited, and academics to wonder how publications in electronic form might be "weighed" (or evaluated professionally) versus conventionally published papers. Editors ask if the peer review system will be bypassed or if electronic publishers might work directly with the authors, paying them any royalties to be derived, and bypass

the society that sponsored the journal in the first place. Authors could opt to follow this route, seeing the potential for collecting user fees that otherwise might accrue to the journal publisher. Electronic publication of primary journals has caused libraries to question the impact of this form of publication on their role in the information transfer scheme, and information processors to ask whether the role of abstracting and indexing services in enabling the user to access the information will change or become redundant.

The level of interest among primary journal publishers, whether commercially- or society-sponsored, for full text electronic storage and publication on demand was the basis for sessions last year at the annual meetings of both the Society for Scholarly Publishing and the Council of Biology Editors. In the context of the CBE session, electronic publishing was discussed more or less as a new concept, rather than an application of a technology that has been widely practiced by other segments of the information industry since the advent of online services. The session, and the term electronic publishing, encompassed two concepts primarily: manuscript transmission from author to publisher in electronic form and publishing on electronic media. In that audience, publishing on electronic media was viewed as a "much newer area for publishers"(23) than electronic transfer from author to publisher. Obviously, some 15 years of electronic publishing and distribution by secondary services, and the lessons to be learned from that experience, were overlooked.

Publishing on electronic media offers advantages for both the publisher and the electronic primary data base producer. In both cases, while opportunity for new and better services to users surely exists, economic considerations may be the greater driving force. For example, Mead Data Central's new service, MEDIS, is available for full text computer searches on more than 50 clinical journals, newsletters and textbooks(24). BRS/Saunders also has an online medical service, COLLEAGUE, from full text storage of primary literature, text books and MEDLINE, provided to users on personal computers. After only a year of COLLEAGUE usage, BRS/Saunders reported no effect on the use of printed versions of the primary sources, saying that a search is for a specific piece of information and thus it is a supplement to, not a substitute for, the printed page. They concluded a formal survey and reported that 37 out of 40 respondents used COLLEAGUE to search through large masses of information for a specific answer and their use of the print had not been affected. Accordingly, Manville of BRS/Saunders(23) states "The issue is not a war between print and computers, but rather the growing demand for information," and suggests that publishers who do not go into full text electronic delivery may decrease exposure of their information to the public.

Whether or not electronic primary journal publishers might accept manuscripts directly from the author, create their own review panels, or delete the peer review process altogether (albeit at the risk of creating unrefereed data bases of lesser value) was not questioned at the CBE session. Even creating their own review committee, if that committee were not selected or sanctioned by the scientific or scholarly societies representing the disciplines of the journals or indeed the sponsors of the journals, could result in the possible loss of revenues and the current primary publisher's role in the publication process as we know it today. Nevertheless, without awareness of the pitfalls, this could seem an attractive alternate to authors or conglomerates of authors, if they, rather than the publishers, could become the recipients of user fees.

Value Added. In assessing the relative roles of traditional primary and secondary services, value added by them must be recognized and measured. As a result of the high level of interest in the concept of electronic journal publication, the editor of CBE Views recently posed the question, "Will Full Text Electronic Publication Bypass the Need for Secondary Services?"

The answer to this question seems to rest, at least in part, in the concept of value added. Information systems are a series of processes by which the potential usefulness of a piece of information being processed is enhanced, i.e., value is added. The secondary services, in my opinion, have done an inadequate job of selling this concept over the years. In fact, the term is relatively new in the literature, for it first appeared in the Journal of the American Society for Information Science in 1982(25), although conceptually and factually, it has existed to a greater or lesser degree since the first abstract journal was published in 1665. The value added to information by secondary services must be measured in both subjective and objective terms. The process is relative and sometimes abstract. This may explain why the secondary services have not promoted the worth of added value more heavily or effectively. Enabling the user to find or access information is the essence of value added by secondary services. Time, energy and money are expended to change inaccessible data to productive knowledge. Value added by secondary services to provide that access encompasses the total process represented by surveillance of the world's body of literature in a given subject area for acquisition, selecting appropriate portions of that literature, translating, abstracting, analyzing, processing, classifying, indexing, providing consistent terminology for retrieval, and finally, disseminating it to its point of use(26,27).

With the advent of online retrieval services has come the concept of value added networks (VAN). Value-added networks incorporate the values as stated above provided by a given data base producer and combining that with similar value from another data base, all via computer interconnections. An example of a product from a value added network is NLM's TOXLINE data base, which combines output from three electronic systems--those of the American Society of Hospital Pharmacists, BIOSIS (Health Effects of Environmental Pollutants) and Chemical Abstracts Service (CBAC). In the case of value added networks, remotely located electronic files interact to effect a product, service or data base that has value that did not exist prior to that interaction. For example, systems in the network might combine a financial and a legal data base, or a biological and business data base, as in the case of BioBusiness. Products of VAN's are sometimes called hybrid data bases.

Electronic publishing offers a multitude of real technological opportunities and at the same time, opportunities for misinformation and unreal claims. User needs must be matched carefully, even cautiously, with technological potential. Electronic publishing is emerging as a complementary, not a replacement technology and promises to continue as such for the foreseeable future(28). While electronic publishing may become a more frequent format than print in some areas, in most cases electronic media and print will continue together. Because electronic forms allow for value added beyond that of the usual printed services, for example the value added network or hybrid data base, the challenge to the producer is to select the "right" subject area to which added value will pay off.

The spread of electronic publishing will surely have an impact on certain secondary services, but it will not replace or eliminate them. Rather it will undergird their role and the importance of the value they add in the information transfer process. However, the spread of telecommunications and electronic data networks has been predicted to lead to a glut of information services in the next decade. Lower prices and increased competition will result in a scramble for niche markets offering special value added services(29).

Optical Disks. During this discussion of electronic publishing, distinction has not been made between publication in magnetic tape format and optical disk formats. This conference, however, is designed to deal with the opportunities and problems that may be ours resulting from the application of optical laser disk technology and other innovations to our industry. This topic will be dealt with in some detail over the next three days. It would therefore be presumptuous for me to undertake a review of the technology per se, or for that matter, to do more than make my personal observations on the state of the art of this aspect of electronic publishing as it relates to secondary services.

Electronic publishing in optical formats offers opportunities for producers, distributors, and users (and possibly even generators) of information. The three main types of information systems in optical format are 1) read only, 2) write once and 3) erasable. Each may be digital or analog.

CD-ROM. Reports have appeared in the literature since the early 60's dealing with optical digital storage technology and its potential importance to information science(30). As a result of huge investments in this technology largely by the home entertainment industry, optical storage is entering almost all segments of the information industry. Optical memory was little more than an engineer's dream in the early 60's when online was first becoming a reality for a few data bases. Twenty years later, only two years ago, the term, CD-ROM, appeared in the popular press(30). Many recent conferences have focused on optical disks in digital read-only memory, or CD-ROM. It is a timely and appropriate topic for discussion at this 28th Annual NFAIS Conference.

Why, one might ask, of the several optical memory formats available, has CD-ROM seemingly become the most relevant to primary and secondary publishers. Some investigators(31) think CD-ROM is probably the most practical, observing that it does "everything you could ask for--it does it all." Julie Schwerin(32) succinctly describes a variety of optical systems for information storage and input. She concludes that read-only media will be used like print, microforms or electronic publication.

The advantages of CD-ROM are said to include its "sparkling fidelity," density or compactness (reportedly, one disk can hold the contents of up to 1500 floppy disks), durability, random access, machine-readable storage, portable computer interfacable format, and reasonably affordable cost. Since CD-ROM permits the user to read only, magnetic tape offers the advantage over that format of write, as well as read, facilitating its use for dynamic data bases that require frequent updates. This read-only feature of CD-ROM can mean a lessening of any threat that might be perceived in terms of its replacing magnetic tape or conventional online services in the immediate future. For this reason, if no other, some experts see CD-ROM as a supplement to magnetic

tape for some time. Nevertheless, the features of CD-ROM as stated, when combined with a personal computer, enable it to provide access to large quantities of information previously available only from large library holdings, or online data bases, the latter with their associated telecommunications cost. For these reasons, experts predict that changes will be felt in almost all areas of the publishing industry as a result of CD-ROM.

Disadvantages of read-only memory disks are few, compared with their advantages. The fact that images cannot be stored efficiently because of the way information is encoded on the disks(31,33) may be seen as a disadvantage, depending on use. Other disadvantages are the inability to write and the difficulty of updating. Costs are a major factor unless many copies are to be made. The master disk must be produced on special equipment in essentially a hermetically-sealed atmosphere, which necessitates the selling of many copies to recover the initial cost. This disadvantage, however, may be offset by the fact that the disk cannot be readily copied, thus eliminating the likelihood of unauthorized downloading.

Schwerin(33) points out that for information users to acquire the hardware and undergo the necessary costs to be able to use optical disks, there must be a critical mass of information available for use on that hardware. She says "The information industry makes money selling solutions, not technology. Optical information delivery systems are merely technology, unless and until information providers use them creatively and successfully to provide value to their customers."

The data base producers must rely on their resourcefulness. They must respond to user needs rather than respond to technological availability. This cannot be overemphasized, as data base producers consider whether to move into CD-ROM now or wait for further developments, or the critical mass. If the decision is to move now, what unique user needs can be met by a product on CD-ROM? If the answer is none, then can a product in this format be justified merely because the technology is available, and is touted to be the hottest item around?

With optical disk formats, information producers can market and distribute directly to users without going through vendors. How to price information to be delivered in this form remains a question, although many seem to think that it will be provided to the user for a fixed use price, rather than on subscription. The user will get unlimited use of the information for that fixed price. Providing information in new formats also makes it necessary to train users and obliges the producer to provide that training as well as the hardware and marketing for the product's success.

What are the risks, the economic implications? Will data base producers be forced to provide services in optical disk media because libraries require them? Will some of the source journals to be indexed and included in the secondary services' data bases be available only on optical disk? If the libraries see CD-ROM as offering advantages that clearly outweigh the disadvantages, can the abstracting and indexing services not respond?

At least three major data base producers, Chemical Abstracts Service, Engineering Information and NTIS have responded. Collectively, they now have five of their data bases available for distribution on CD-ROM developed by Digital Equipment Corporation(34). Also, ERIC and the American Psychological Association's PSYCHLIT are producing data bases on "Silver Platters."

Reportedly(21) the advantages of electronically- and optically-published media from the libraries' standpoint, include density that results in less storage space requirements, easier storage, improved information dissemination and improved access to information. It has been suggested that libraries would save money from the cancellation of subscriptions to printed abstract journals and expensive cumulative indexes, as well as subscriptions to primary journals and newsletters that could be obtained on optical disk. Offsetting this, user preference is seen as a potential problem, as a user might consider that not having the whole document before him for browsing and the lack of pictorial or graphic material as disadvantages. Also the end users could bypass the library altogether.

In more or less direct ways, the libraries' concern can be extrapolated to apply to the data base producer. The possibility of the data base producer getting back in touch with the end user undoubtedly has appeal. The opportunity to monitor user needs, to obtain user feedback on existing products and to discover niche markets for specialized data bases is returned to those who create the data bases. The producer can work with a new point of sale in delivering customer satisfaction, and in bringing awareness and locator skills. Or will that be the case? While CD-ROM enables end user interaction and delivery without the intermediary interface, what about locator services? Will the user who can access large masses of published information on disk locate the desired piece of information or reference without the aid of the abstracting and indexing services, whether or not it is provided on CD-ROM? Will the bibliographic services be used in disk format by the end user, who will in turn go to the full text or request document delivery in optical disk format for his PC? Will CD-ROM enable bibliographic data base producers to expand their markets, reach new markets and new opportunities for sales, or will the result be a redistribution of the same revenues with migration from print or online to CD-ROM?

What will be the impact of this on the economics of information transfer, and especially on economics of secondary services? Optical memory is a high risk, high tech entrepreneurial endeavor with the potential for enormous effect on our business. Although that impact can only be revealed over time, for some producers, now is the time for action. For others, now is the time to take a close look and to be ready when the opportunities arise. We must be careful that our decisions are in response to needs rather than a response because of the availability of technology.

Summary. In summary, it can be said that applications of technology since the 50's have brought profound changes in the communications field and specifically in the processing and delivery of access or bibliographic retrieval services. These applications, often innovative in nature, have enabled choices and demanded decisions by abstracting and indexing services. Now known as data base producers, they have had such options for a relatively short portion of their history, i.e., for some 30 years only. The vast impact has been not only on

the way information is processed and delivered to its point of use, but also on the way that information is used. These innovations have necessitated and resulted in the creation of entirely new links in the information transfer chain, notably, the role of the vendor and information broker. They have also resulted in a sort of estrangement between the data base producer and his user, as a result of these new elements. The technologies leading to these innovations became, and continue to be, the foundation for many "cause and effect" situations. While they enabled the secondary services to cope with enormous quantities of literature and provided the means by which faster and more efficient delivery was possible, they also brought about the opportunity for violation of copyright and the pirating of information in electronic form, the decline in revenues from hard copy and the introduction of the concept of information as a commodity which should be paid for according to use, and probably by its user. They created opportunities for entrepreneurs and even government agencies to move into markets and compete with traditional abstracting and indexing services that had dominated, for the most part, in the print-only era.

One should question whether leaders in our industry have permitted technology to lead or whether we have responsibly used technology for the advantages it can provide to the communities of users that we serve, as well as for the economic well-being of our organizations. Have data base producers, in all cases, sufficiently evaluated the impact that technological change will have on their survival and way of doing business? Will the application of new technology for the preparation of manuscripts and the publication of primary journals enable information retrieval from full text storage, and thereby reshape the direction of secondary services without those services actively participating in the decisions? Will optical disk memory and laser disk technology determine the future for secondary information services? Will the decisions that we make, in the long run, appreciably influence the impact that this technology will have on our services, or will (and can) the technology overpower the judgment of the services?

This review over three decades and a careful look at the present leads me to make the following projections for the decade ahead. We will experience an overwhelming diversity of technological advances that will make computers more commonplace, more user-friendly, faster, cheaper and more powerful, enabling more storage and quicker access. The need for carefully weighed decisions and the available options will be greater than ever. The right choices can lead to enormous success; however, there will be more opportunities for making the wrong decisions. While it may be the most challenging of all times for secondary information services, it promises to be the most exciting.

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